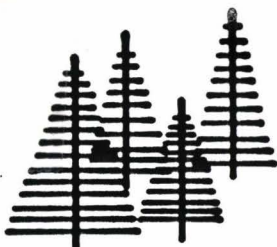


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PEST DAMAGE SURVEY OF FOUR PONDEROSA PINE PROGENY TEST AREAS IN SOUTHERN IDAHO

by

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INTRODUCTION

In the early 1960's a ponderosa pine tree improvement program was initiated in west-central Idaho through the cooperative efforts of the USDA Forest Service, the USDI Bureau of Land Management, the State of Idaho Department of Lands, and private industry (Wang 1967). Currently this consortium is called the Southern Idaho Tree Improvement Cooperative (SITIC).

Three sequential steps were outlined in the work plan for the tree improvement program. The first step, called the Phase I progeny test, was a large-scale screening of native ponderosa pine stands in west-central Idaho for desirable parent material. Cones were collected in 36 natural ponderosa pine stands (populations) from 271 "superior" mother trees that exhibited above average form, vigor, and growth characteristics. The seeds were planted at the USDA Forest Service, Lucky Peak Forest Nursery near Boise, Idaho, and resulting 2-0 seedlings were outplanted in 1966 in four 12- to 14-acre plantations. Four-tree linear clusters from each of the 271 mother tree families (half-siblings) were established in ten complete randomized blocks within each plantation.

Based on height/growth ranking results in 1971 (Wang and Patee 1976), about 100 of the 271 Phase I progeny were selected for further field evaluation. Additional candidate mother trees, identified during field reconnaissance in the interim years since 1965, were selected for testing. Seedlings derived from these sources were reared at the Lucky Peak Nursery and outplanted in 1975 in four new locations and became known as the Phase II progeny test plantations.

The final step, to be completed in the later 1980's, involves the establishment of a seed orchard from the best Phase I and II trees.

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In the 1970's SITIC requested that Forest Pest Management evaluate existing and potential insect, disease, and other damaging agents in the four Phase I progeny test areas. This report documents our evaluation.

OBJECTIVES

1. Identify and quantify agents of tree damage in the four Phase I progeny test areas.
2. Evaluate the effects of the identified damage agents on the tree improvement effort.

METHODS

The four Phase I progeny test plantations are as follows:

<u>Plantation Name</u>	<u>Elevation</u>	<u>Administrator</u>
Idaho City	4,000 feet	Bureau of Land Management
Holcomb	3,700 feet	Boise National Forest
Boulder Creek	4,750 feet	Payette National Forest
Jack's Creek	5,350 feet	Idaho Department of Lands

Between June 1981 and March 1982, a two-person crew inspected every tree in each Phase I progeny test plantation for any signs or symptoms of insect, disease, mechanical, or animal damage. Nine damage agents or conditions were noted and are listed below with associated symptomology:

1. Western gall rust, Endocronartium harnessii - one or more active or inactive galls on the branches or stems.
2. Annosus root disease - confirmed by presence of Fomes annosus sporophore on recently killed trees; green or fading trees were not excavated.
3. Terminal insects - damage to the main stem and lateral branch terminals was caused mainly by two insects--the western pineshoot borer (Eucosma sonomana) and the terminal weevil (Pissodes sp.). Symptoms included either dead shoots or stunted terminals on the most recent year's growth.
4. Pitch moth, Petrova sp. - copious mounds of pitch on the stem usually near a branch whorl.
5. Eurytomid wasps - caused a distinctive swelling and pitting on lateral branches.
6. Sapsucker, Sphyrapicus sp. - matrices of puncture wounds spaced closely together on tree trunks indicate damage from this member of the woodpecker family.
7. Mechanical injury - a composite category to include any visible damage caused by physical forces. Three subcategories were identified: (1) snow damage, characterized by bent, misshapen stems and branches; (2) forked trunk; and (3) top out (broken off or removed terminal).

8. Unknown mortality - all tree mortality that could not be ascribed to other damage agents within the last five years as evidenced by the retention of bark and/or needles.

RESULTS AND DISCUSSION

Out of about 43,360 trees planted in 1966, only 14,257 trees remained for the damage inspection. Four of the ten blocks (4,336 trees) in the Jack's Creek plantation had poor survival two years after planting due to a pocket gopher infestation and were destroyed without replacement. The Boulder Creek Plantation was thinned in 1978 from four- to two-tree plots in each of the ten blocks for a reduction of about 5,420 trees.

Results of the damage survey are presented in table 1.

Table 1. Pest/damage survey of four ponderosa pine progeny test areas in southern Idaho.

	Holcomb		Idaho City		Jack's Creek		Boulder Creek		Total	
	---		Total number of trees		---					
	3,518		5,063		1,438		4,238		14,257	
Damage Category	Damaged	%	Damaged	%	Damaged	%	Damaged	%	Damaged	%
Mech. Injury:										
Snow damage	53	1.5	90	1.8	273	19.0	2,922	68.9	3,338	23.4
Forked trunk	450	12.8	152	3.0	124	8.6	57	1.3	783	5.5
Top out	76	2.2	90	1.8	162	11.3	42	1.0	370	2.6
Terminal insect:	1,303	37.0	1,831	36.2	352	24.5	23	0.5	3,509	24.6
West. gall rust:	9	0.3	32	0.6	661	46.0	992	23.4	1,694	11.9
Pitch nodule	69	2.0	61	1.2	247	17.2	11	0.3	388	2.7
Sapsucker	108	3.1	80	1.6	163	11.3	20	0.5	371	2.6
Eurytomids	31	0.9	16	0.3	0	0.0	1	0.0	48	0.3
Mortality:										
Annosus root disease	0	0.0	20	0.4	0	0.0	0	0.0	20	0.1
Unknown cause:	26	0.7	13	0.3	14	1.0	18	0.4	71	0.5
No damage	1,862	52.9	2,867	56.6	712	49.5	885	20.9	6,326	44.4

Mechanical injury was the most frequently noted damage with 30.5 percent of the total number of trees being affected. Snow damage was the leading subcategory being found on 3,338 trees representing 23.4 percent of the survey population. Snow damage was most notable in the two high-elevation plantations, with over

two-thirds (68.9 percent) of the trees in the Boulder Creek plantation and 19 percent at the Jack's Creek plantation being affected. Forked trunks were noted on 5.5 percent of the trees and 2.6 percent had the most recent year's top broken out.

The latitudinal range of the 36 mother tree population locations was 200 miles and ranged in elevation from 3200 feet to 6500 feet. The median elevation was 4500 feet. Therefore, some expression of off-site influence could be expected in both the Jack's Creek (5,350 feet) and Boulder Creek (4,750 feet) plantations as they are above the elevational zone of more than 50 percent of the parent stock. Trees in the Boulder Creek plantation may have been subjected to snow damage (widespread stem crooking) resulting from snow creep on the especially steep slopes (approaching 35 percent) in the late winter. Field notes indicate that, despite all the snow damage, this plantation had the tallest trees of the four progeny test plantations.

Terminal insect damage was found on 3,509 trees, almost one-quarter of the total surveyed population. The variation of terminal insect damage occurrence between plantations was slight, ranging from 24.5 percent to 37.0 percent with the exception of the Boulder Creek plantation where only 0.5 percent of the trees were affected. This disparity may be partially explained, because as mentioned previously, the trees in the Boulder Creek plantation were much taller than in the other progeny test areas. Consequently, field crews may not have had a clear view of terminal and lateral branch tips. In any case, the subject needs further investigation.

Overall, about 12 percent of the progeny test trees are infected by western gall rust. However, the majority of infections occurred in the two higher elevation plantations--Jack's Creek (46 percent) and Boulder Creek (23 percent). In contrast, only 0.3 percent and 0.6 percent rust incidence was noted in the Holcomb and Idaho City plantations, respectively. During the 1978 thinning in the Boulder Creek plantation, presence of gall rust was one of several cutting criteria. Undoubtedly, the incidence of the rust found during the 1981 survey in that area was reduced by the previous thinning. The extreme variation in rust occurrence suggests a relationship between rust incidence and plantation location. As galls can be found in natural stands immediately surrounding all four plantation sites, environmental factors are the likely cause of the variations in disease incidence.

Pitch nodule moth damage was found on 388 trees representing 2.7 percent of the total survey population. The highest incidence of the pest was in the Jack's Creek plantation where 17.2 percent of the trees were attacked. Furniss and Carolin (1977) consider pitch moths to be minor pests of young trees, but note that because the insects bore deeply into trees, stems may be predisposed to breakage by wind or snow. It is probable that much of the mechanical damage (top out and forked trunk) reported in the Jack's Creek plantation resulted directly or indirectly from pitch nodule moth attacks.

Sapsuckers damaged a total of 371 trees (2.6 percent). The puncture wounds caused by these birds are extensive enough to girdle and kill some trees. Undoubtedly other trees will succumb to stem rot resulting from invasions by decay fungi through wounds. While the number of affected trees overall is low, observers noted that often an entire four-tree cluster was affected. Followup analyses of individual family or groups of families (populations) may indicate genetically conditioned susceptibility.

Early in the survey, swellings caused by Eurytomids were initially thought to be incipient infections of western gall rust. After several examinations of questionable branch swellings, the field crews correctly differentiated the damage symptoms and then continued to record the insect damage. Only 48 trees were found infected by the gall-forming insect, and 31 of these were in the Holcomb plantation. The localized branch swellings appear to cause little harm to individual trees; thus, they will not have any bearing on the tree improvement effort. Damage is included in this report because the pest may be of academic interest.

Of most significance to the tree improvement effort were the 91 trees, representing 0.6 percent of the total number of trees that had died within the five year period prior to the survey. Cause of death could not be determined on 71 trees. *Fomes annosus* sporophores were detected on excavated roots or root collars of the remaining 20 trees. They were only found in the Idaho City plantation which has been previously evaluated for this disease (Marshall and Hoffman 1983). Significantly, of the four Phase I plantation sites, stumps were not removed from only the Idaho City plantation. This adds credence to the standard theory that the fungus infects cut stump surfaces, decays old roots, and then infects roots of nearby seedlings/saplings.

No damage was observed on 6,326 trees (or 44.4) percent of the surveyed population. This percentage, however, was not representative of the Boulder Creek plantation as nearly four out of every five trees was affected by some damaging agent with snow damage accounting for 72 percent of the damage.

RECOMMENDATIONS

Mechanical injury symptoms were noted on almost one-third of all the progeny test trees. By itself this is not unexpected because of the broad elevational and latitudinal ranges of the tested trees (Wang 1967). Most notable is the large amount of mechanical injury that occurred in the Boulder Creek plantation which we feel is related to snow and ice creeping down slopes. Testing conducted on level sites might eliminate much of this problem.

Terminal insects are the largest single biotic factor causing damage to the surveyed plantations. They are important because they affect tree growth and form. Control of these pests, however, is based on the management objectives of the cooperative. As Thier (1985) pointed out, control techniques are warranted if the cooperative wants to prevent possible height growth effects, in which case the plantations would have to be treated annually. If the cooperative decides, however, that their real objective is to determine how various progeny may grow under natural conditions, then control efforts are not recommended.

Western gall rust is both a current and potential problem to the tree cooperative effort. Active galls can produce inoculum to spread the disease throughout the progeny test plantations. We recommend monitoring gall rust incidence during the scheduled height growth measurement surveys with followup FPM data evaluation. In addition, statistical analyses are currently being conducted to determine whether genetic resistance or susceptibility to gall rust is expressed in some of the evaluated families or populations.

Western gall rust incidence, as detected in this survey, was minimal in the two lower elevation plantations. However, while it appears there may be a statistical relationship between these two variables, the apparent association of elevation and gall rust incidence likely arises from similarities of environmental conditions favorable for disease development. In any case, the subject needs further study. In the meantime it would seem prudent to inspect all the test sites again, and in areas of high gall rust incidence, consider eliminating all gall rust-infected trees within 1,000 feet of a plantation boundary to buffer the progeny from future infections.

Fomes annosus damage in the Intermountain West has not yet been fully evaluated. However, based on the experiences in the Idaho City plantation, it makes good economic and common sense to consider stump removal as a standard procedure in the establishment of future progeny test areas.

The remaining damaging agents should cause minimal problems for the tree improvement effort, but are noteworthy pieces of baseline information.

Of some reassurance were the findings that 44 percent of the surveyed trees were without damage symptoms. However, it should be remembered that over the course of 15 years, nearly two-thirds of the planted Phase I progeny test trees perished, mostly without quantitative explanation.

ACKNOWLEDGMENTS

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